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**CUSTOMISED MAGNETICS
(INDUCTORS, TRANSFORMERS)**

BASED ON TYPE FT

ESCC Detail Specification No. 3201/013

Issue 1	March 2020
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1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

1.2 APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

- (a) ESCC Generic Specification No. [3201](#).
- (b) ECSS-Q-ST-70-71, Materials, Processes and their Data Selection.
- (c) ECSS-E-HB-20-05, High Voltage Engineering and Design Handbook.
- (d) IEC Publication No. 60304, Standard Colours for Insulation for Low-Frequency Cables and Wires.
- (e) IEC Publication No. 60317-0-1, Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire.

1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. [21300](#) shall apply. In addition, the following definition shall apply:

- Effective Core Area: The minimum physical area of the core through which the total flux runs.

1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example: 320101301F12345678

- Detail Specification Reference: 3201013
- Component Type Variant Number: 01 (see Note 1)
- Manufacturer Specific Magnetic Identification: F12345678 (as applicable) where:
 - First letter of the applicable Manufacturer's name: F (as applicable)
 - Characteristic code: Magnetic type (Choke): 12 (as required)
 - Characteristic code: Core Size, A_p (34mm⁴): 34 (as required)
 - Characteristic code: Termination type (Potted flying leads): 5 (as required)
 - A unique 3 digit code, allocated by the applicable Manufacturer to a specific transformer/inductor design: 678 (as applicable)

NOTES:

1. Marking of the type variant number is mandatory. No further reference to type variant number is made in this specification

1.4.1.2 Characteristics Codes

Characteristics to be codified as part of the ESCC Component Number and Manufacturer Specific Magnetic Identification shall be as follows:

- (a) Magnetic type expressed by means of the following codes:

Magnetic Type Designation and Description	Code
Chokes, Inductors	12
Pulse, Transformers	14

- (b) Core size, A_p , defined as core cross section area (in mm^2), A_c , times the winding area, A_w (in mm^2). The unit quantity shall be mm^4 .

Core size (A_p)	Code (mm^4)
$A_p = A_c \times A_w$	XX

- (c) Termination type expressed by means of the following codes:

Termination Type	Code
Pin/ex-striplines	0
Flying leads /striplines	1
Open solder terminal	2
Open pin terminal	3
Potted pin	4
Potted flying leads	5
Closed solder terminal	6
Closed pin terminal	7
Potted SMD	8
SMD	9

1.4.2 Range of Components

The range of components applicable to this specification are as follows:

Physical, Electrical and Thermal Configuration	Available Options
Magnetic Type (Note 1)	Single element assemblies only: Inductor(s); Transformer
Package Type (Note 2)	Open Construction; Housed; Potted
Termination Type	Through-hole; SMD; Flying Leads
Winding Wire (Note 3)	Ø0.1mm to 2mm wires per IEC 60317-0-1; Custom Foils
Maximum Power (Note 4)	2.5kW
Maximum Operating Temperature (Note 4)	+130°C

NOTES:

- The following customised types/designs are available. The particular type/design will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).
 - Single or multi-coupled inductors
 - Common mode chokes / Differential
 - Power transformers (flyback, forward, push-pull, half/full bridge, specific architectures)
 - Signal transformers
 - Pulse transformers
 - Current/voltage measurement transformers
 - Specific magnetic functions within environment and thermal requirements
 - Integrated Magnetics
 - Spike Killer
 - High Frequency
 - High Voltage
 - Other specific magnetic function
- See Para. 1.6.
- See Para. 1.8.
- The maximum ratings of a particular component are determined by the specific electrical and material design; they will be specified in the applicable Magnetic Sheet. See Para. 1.5. See also Para. 1.8.

1.4.3 Manufacturer Specific Magnetic Identification

A Magnetic Sheet shall be produced by the Manufacturer, after negotiation with the Orderer, that, as a minimum, specifies all the requirements unique to the specific magnetic component design that are identified herein as being specified in the Magnetic Sheet.

The Magnetic Sheet shall be held under configuration control by the Manufacturer. For identification and traceability purposes, the Manufacturer shall allocate a unique Manufacturer Specific Magnetic Identification to the Magnetic Sheet and the specific magnetic design, as specified in Para. 1.4.1.

The requirements to be specified in the Magnetic Sheet for a particular component shall be as follows:

Para. Reference	Requirements (as applicable)
1.4.2	Particular type/design details.
1.5	All maximum ratings: P, I _R , DWV, f, T _{op} , T _{stg} , T _{sol} .
1.6	All relevant external physical dimensions including Effective Core Area.
1.6	Termination identification details including colour coding details.
1.6	Recommendations for mounting, and, for components with moveable structures within its physical design, recommendations for staking or glueing of the component body and other structures to the mounting surface.
1.7	Functional diagram.
1.8	All materials and finishes used.
2.1.1.1(a)	Whether the component is defined as High Voltage and therefore requires a Partial Discharge test; applicable test conditions shall be specified when required.
2.2	Complete Marking details.
2.3.1	Full details of all characteristics, test sequence, test conditions and limits that apply during Room Temperature Electrical Measurements.
2.3.2	Full details of all characteristics, test sequence, test conditions, limits and sampling that apply during High and Low Temperatures Electrical Measurements.
2.4	Full details of all characteristics, test sequence, test conditions and limits that apply during Intermediate and End-Point Electrical Measurements.
2.5	Burn-in test conditions.
2.6	Operating Life test conditions.
-	The maximum weight of the component shall be specified for information.
-	Full details of any deviations to the requirements of the Detail Specification or Generic Specification as agreed with the ESCC Executive.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Power	P	Note 1	W	≤ 2.5kW
Rated DC Current	I _R	Note 1	A	≤ 35A
Dielectric Withstanding Voltage	DWV	Note 1	V _{rms}	
Operating Frequency	f	Note 1	Hz	≤ 500kHz
Operating Temperature Range	T _{op}	-55 to +130 (Note 2)	°C	T _{amb}
Storage Temperature Range	T _{stg}	-55 to +130 (Note 2)	°C	
Soldering Temperature	T _{sol}	Note 1 (+260 for SnPb, +300 for SnAg)	°C	Note 3

NOTES:

1. This Maximum Rating for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).
2. This is the absolute maximum temperature range for the full range of components covered by this specification. The actual maximum temperature range for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).
3. Unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3): duration 5 seconds maximum, the same terminal shall not be resoldered until 3 minutes have elapsed.

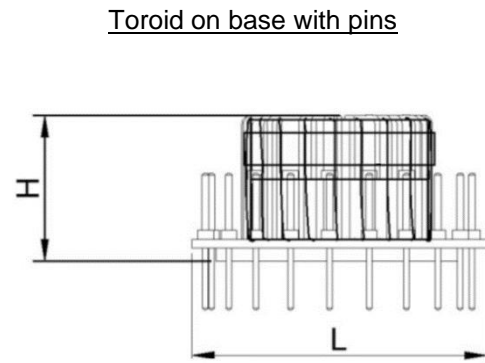
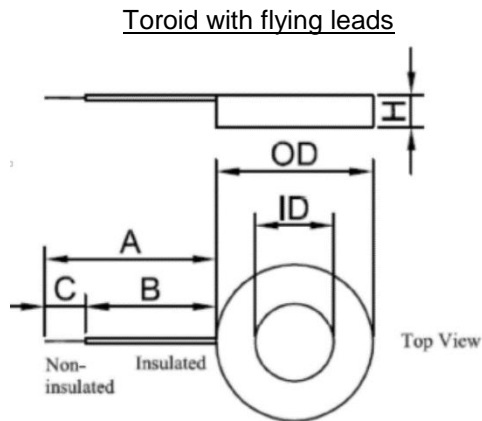
1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

The physical dimensions and terminal identification for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).

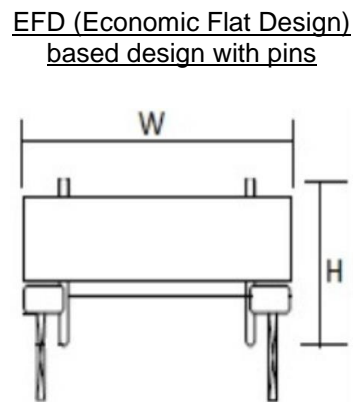
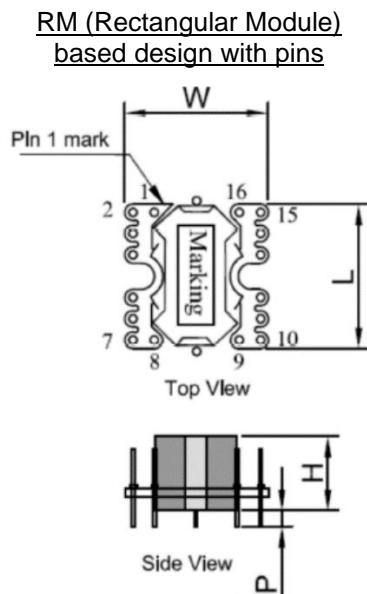
NOTES:

1. The overall dimensions for the range of cores used in components against this specification, depending on the design type used, are as follows:

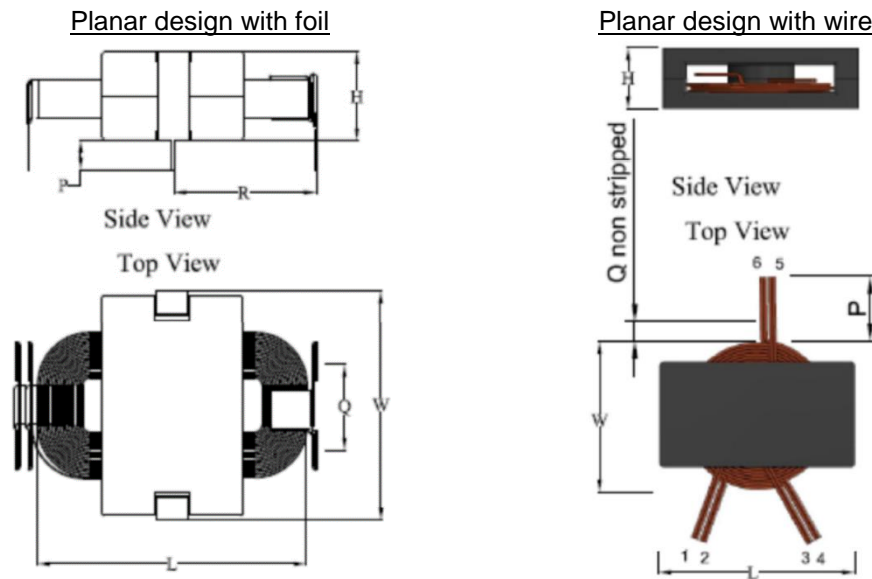
- For toroid based designs: Effective Core Area = 2mm^2 to 199mm^2 ; see examples below:



- For coil former based designs: Effective Core Area = 2.66mm^2 to 146mm^2 ; see examples below:



- For custom designs: Effective Core Area = 0.14mm² to 484mm²; see examples below:

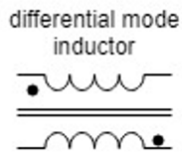
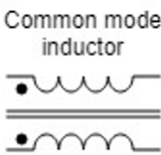
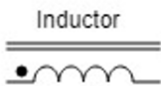
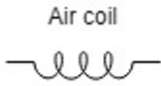


- Unless otherwise specified in the applicable Magnetic Sheet and where applicable, terminals shall be colour coded by means of a length of silicone tubing, in accordance with IEC 60304.
- For any component that has any moveable structures within its physical design, in order to preclude any risk of damage in physical environments, the applicable Magnetic Sheet shall provide recommended mounting details including, as applicable, recommendations for staking or glueing of the component body and other structures to the mounting surface.

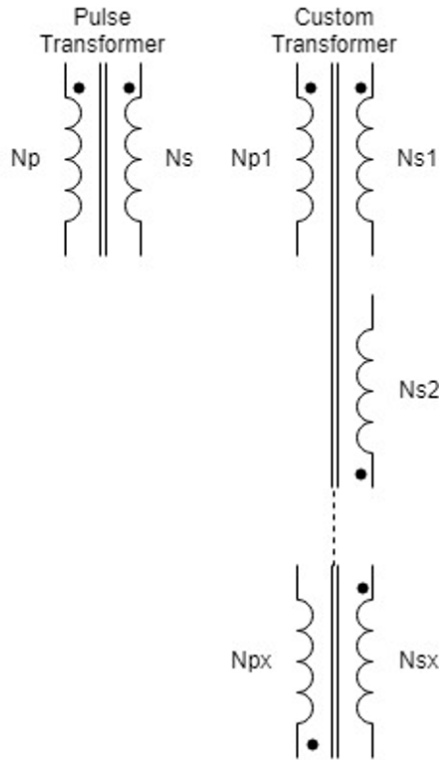
1.7 FUNCTIONAL DIAGRAM

The functional diagram for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3). Examples of the available ranges of inductors and transformers are as follows:

Inductors



Transformers



1.8 MATERIALS AND FINISHES

The materials and finishes including case and terminals for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3) as extracted from the Manufacturer's Declared Materials List (DML). All materials shall meet the requirements of ECSS-Q-ST-70-71.

The material breakdown temperature for all materials of a particular component shall be a minimum of +25°C above the applicable maximum operating and storage temperature (as specified in Para. 1.5 Maximum Ratings).

2 REQUIREMENTS

2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

2.1.1 Deviations from the Generic Specification

2.1.1.1 *Deviations from Screening Tests – Chart F3*

- (a) **Partial Discharge Test**
Components defined as being High Voltage in the applicable Magnetic Sheet (see Para. 1.4.3) shall be subjected to a 100% Partial Discharge Test in accordance with ECSS-E-HB-20-05 Para. 6.1.6 and as follows. The test shall be performed after Burn-in and prior to final Room Temperature Electrical Measurements.
 - i. Level of testing: 1
 - ii. Specific test conditions shall be as specified in the applicable Magnetic Sheet.
 - iii. Any failures to this test shall be taken into account during Check for Lot Failure.

2.1.1.2 *Deviations from Qualification and Periodic Testing – Chart F4*

- (a) Para. 8.6, Barometric Pressure: shall not be performed.
- (b) Para. 8.12, Immersion: shall not be performed.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. [21700](#) and as follows.

As a minimum, the information to be marked on the component or the primary package shall be:

- (a) Terminal Identification (see Para. 1.6)
- (b) The ESCC qualified components symbol (for ESCC qualified components only).
- (c) The ESCC Component Number (see Para. 1.4.1)
- (d) Traceability information.

The complete marking shall be as specified in the applicable Magnetic Sheet (see Para. 1.4.3).

2.3 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

2.3.1 Room Temperature Electrical Measurements

The measurements shall be performed at $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$.

Characteristics (Note 1)	Symbols	Test Method and Conditions (Note 1)	Limits		Units
			Min	Max	
Inductance	L	ESCC No. 3201	Note 1		μH
DC Resistance	R_{DC}	ESCC No. 3201	Note 1		Ω
Insulation Resistance	R_I	ESCC No. 3201	Note 1	-	$\text{M}\Omega$
Dielectric Withstanding Voltage	DWV	ESCC No. 3201 Electrification time $\geq 5\text{s}$	Note 1		Vrms
Dielectric Withstanding Voltage Leakage Current	I_{DWV}	ESCC No. 3201 Electrification time $\geq 5\text{s}$	Note 1		μA
Turns Ratio	TR	ESCC No. 3201	Note 1		-
Voltage Ratio	VR	ESCC No. 3201	Note 1		-
Polarity	POL	ESCC No. 3201	Note 1		-
Capacitance	C	ESCC No. 3201	Note 1		pF
Quality Factor	Q	ESCC No. 3201	Note 1		-
Centre-tap Resistive Unbalance	B_R	ESCC No. 3201	Note 1		%
Centre-tap Inductive Unbalance	B_L	ESCC No. 3201	Note 1		%
Phase Shift	PS	ESCC No. 3201	Note 1		$^\circ$
Primary Impedance	Z_P	ESCC No. 3201	Note 1		Ω
Frequency Response	R_f	ESCC No. 3201	Note 1		dB
Self-Resonant Frequency	f_r	ESCC No. 3201	Note 1		MHz
Harmonic Distortion	THD	ESCC No. 3201	Note 1		%
Insertion Loss	IL	ESCC No. 3201	Note 1		dB
Waveshape	WAVE	ESCC No. 3201	Note 1		-

NOTES:

1. The actual characteristics, test sequence, test conditions and limits that shall apply for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).

2.3.2 High and Low Temperatures Electrical Measurements

Characteristics (Note 1)	Symbols	Test Method and Conditions (Notes 1, 2)	Limits		Unit
			Min	Max	
Characteristic Change over Operating Temperature Range	-	See Para. 2.3.1 Note 2	Note 1		%

NOTES:

1. The actual characteristics, test sequence, test conditions including test temperature(s), and limits that shall apply for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).
2. Unless otherwise specified, the measurements shall be performed on a sample of 5 components from the lot with 0 failures allowed. In the event of any failure a 100% inspection may be performed.

2.4 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}C$.

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Room Temperature Electrical Measurements.

Test Reference per ESCC No. 3201	Characteristics	Symbols	Limits		Units
			Min	Max	
Thermal Shock	As per Para. 2.3.1 (1)	-	Note 1		-
Temperature Rise Initial Measurements	DC Resistance (at $0.1I_R$)	R_{DC}	Record Value		Ω
Final Measurements (within 30s of the removal of power)	DC Resistance (at I_R) Temperature Rise	R_{DC} ΔT	Record Value Note 1		Ω $^{\circ}C$
Overload	As per Para. 2.3.1 (1, 2)	-	Note 1		-
Resistance to Soldering Heat	As per Para. 2.3.1 (1, 2)	-	Note 1		-
Moisture Resistance Within 30 min of removal from conditioning:	Dielectric Withstanding Voltage (2) DWV Leakage Current (2) Insulation Resistance	DWV I_{DWV} R_I	Note 1 Note 1 100	-	Vrms μA $M\Omega$
Within 1 hour of previous measurements:	As per Para. 2.3.1 (1, 2)	-	Note 1		-

Test Reference per ESCC No. 3201	Characteristics	Symbols	Limits		Units
			Min	Max	
Operating Life Initial Measurement (0 hour)	As per Para. 2.3.1 (1, 2)	-	Note 1		-
Intermediate Measurements (1000 hours) (after 30 min recovery)	As per Para. 2.3.1 (1, 2)	-	Note 1		-
Final Measurements (2000 hours) (after 30 min recovery)	As per Para. 2.3.1 (1, 2)	-	Note 1		-

NOTES:

1. The actual characteristics, test sequence, test conditions and limits that shall apply for a particular component will be specified in the applicable Magnetic Sheet (see Para. 1.4.3).
2. For DWV, the electrification time shall be ≥ 1 minute.

2.5 **BURN-IN CONDITIONS**

Unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3), the conditions shall be as specified in the Generic Specification.

2.6 **OPERATING LIFE CONDITIONS**

Unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3), the conditions shall be as specified in the Generic Specification.

APPENDIX A
AGREED DEVIATIONS FOR FLUX A/S (DK)

Items Affected	Description of Deviations
Para. 2.1.1 Deviations from the Generic Specification: Deviations from Production Control – Chart F2	Para. 5.2.2, Dimension Check: shall only be performed during initial qualification testing or on the first lot produced after a change in any dimension has been agreed and implemented into this ESCC Detail Specification or a particular Magnetic Sheet (see Para. 1.4.3).
Para. 2.1.1 Deviations from the Generic Specification: Deviation from Screening Tests – Chart F3	Serialisation: A 100% serialisation, performed prior to Chart F3 with subsequent Electrical Measurements at Room, High and Low Temperatures performed read and record, is optional at the Manufacturer’s discretion. Para. 8.4, Burn-in: The following deviations shall apply: <ul style="list-style-type: none"> • The test duration shall be 96 (+4 -0)h • The test temperature shall be $T_{amb} = +120 \pm 5^{\circ}C$
Para. 2.1.1.1 Deviations from Qualification and Periodic Tests - Chart F4	Para. 8.7, Temperature Rise: This test shall be performed as a minimum only during initial qualification testing. It need not be performed during Maintenance of Qualification unless there has been a major change to the PID affecting quality, reliability, fit or function of the components. Para. 8.8, Overload: The primary shall be be loaded with 112% of rated input current. The test temperature shall be $T_{amb} = +125 (+0 -5)^{\circ}C$. The test period shall be ≥ 48 hours. Para. 8.9, Resistance to Soldering Heat: shall not be performed. Para. 8.10, Mechanical Shock: <ol style="list-style-type: none"> i. For Qualification Testing, and Periodic Testing for renewal of qualification after lapse: test condition: D (half sine, 500g, 1ms) shall apply. ii. For Periodic Testing for extension of qualification: test condition I (sawtooth, 100g, 6ms) shall apply. Para. 8.11, Vibration: shall be replaced by a random vibration test in accordance with MIL-STD-202 Method 214 with the following conditions: <ul style="list-style-type: none"> • Mounting: the components shall be securely fastened by their normal mounting means. • Test condition: based on test condition H but with: <ul style="list-style-type: none"> ○ Power spectral density: $0.5g^2/Hz$ (30grms) for 100 to 1600Hz, with +6dB/octave for 20 to 100Hz, and -12dB/octave for 1600 to 2000Hz ○ Duration: 3 minutes/axis Data Points: On completion of testing, all windings shall be checked for electrical continuity by any suitable means that will not introduce currents in excess of the rated value. The components shall then be visually examined. There shall be no evidence of any damage. Para. 8.13, Moisture Resistance: The initial thermal shock test shall not be performed. The Dielectric Withstanding Voltage and Insulation Resistance tests required within 30 minutes of removal after the test, shall not be performed.

Items Affected	Description of Deviations
	<p>Para. 8.14, Operating Life: Unless otherwise specified, shall be replaced by either Passive Life or Operating Life, as specified in the applicable Magnetic Sheet (see Para. 1.4.3), as follows:</p> <p>1) <u>Passive Life</u> MIL-STD-202, Method 108 with the following details:</p> <ul style="list-style-type: none"> • Mounting: the components shall be mounted on racks or on a PCB • Duration: <ul style="list-style-type: none"> ○ 2000 (+48 -0) hours for Qualification Testing, and Periodic Testing for renewal of qualification after lapse. ○ 1000 (+48 -0) hours for Periodic Testing for extension of qualification. • Ambient test temperature: +105 ±3°C unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3). • Operating conditions: Non-operating. <p>Data Points: Intermediate and End-Point Electrical Measurements shall be performed as specified in the applicable Magnetic Sheet at 0, 1000 hours, and 2000 hours (if applicable). If drift values are specified, the drift shall always be related to the 0-hour measurement. The components shall be stabilised at ambient room conditions for a minimum of 30 minutes after removal from the test chamber, prior to the performance of measurements. On completion of testing, the components shall be visually examined. There shall be no evidence of any damage.</p> <p>2) <u>Operating Life</u> MIL-STD-202, Method 108 with the following details:</p> <ul style="list-style-type: none"> • Mounting: the components shall be mounted on racks or on a PCB • Duration: <ul style="list-style-type: none"> ○ 2000 (+48 -0) hours for Qualification Testing, and Periodic Testing for renewal of qualification after lapse. ○ 1000 (+48 -0) hours for Periodic Testing for extension of qualification. • Operating conditions: 5 ON/OFF cycles/week as follows: <ul style="list-style-type: none"> ○ Cycles 1 to 4: ON for 20 hours: operating at +105 ±3°C unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3), plus OFF for 3 hours: non-operating at T_{amb} = +22 ±3°C followed by: <ul style="list-style-type: none"> ○ Cycle 5: ON for 68 hours: operating at +105 ±3°C unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3), plus OFF for 3 hours: non-operating at T_{amb} = +22 ±3°C <p>During ON periods, unless otherwise specified in the applicable Magnetic Sheet, the component with all normally loaded secondaries loaded with their specified impedances, shall be loaded with 100% rated power as specified in the applicable Magnetic Sheet.</p> <p>Data Points: Intermediate and End-Point Electrical Measurements shall be performed as specified in the applicable Magnetic Sheet at 0, 1000, and 2000 hours (if applicable). If drift values are specified, the drift shall always be related to the 0-hour measurement. The components shall be stabilised at ambient room conditions for a minimum of 30 minutes after removal from the test chamber, prior to the performance of measurements. On completion of testing, the components shall be visually examined. There shall be no evidence of any damage.</p>

Items Affected	Description of Deviations
	<p>Para. 8.16, Solderability: this test shall be performed in accordance with MIL-STD-202 Method 208 with a soldering iron test method as follows:</p> <p>Note: Not applicable for components with flying leads.</p> <ul style="list-style-type: none"> • A minimum of 2 of each type of terminal shall be tested. • Soldering iron tip temperature: +330 ±10°C • Duration of application: 2 ±0.5s • Materials: Solder Sn63Pb37; flux RMA <p>Data Points: On completion of testing, the components shall be visually examined. There shall be no evidence of any damage or loosening of terminals.</p> <p>Para. 8.17, Terminal Strength: Unless otherwise specified in the applicable Magnetic Sheet (see Para. 1.4.3), the Terminal Strength shall be tested as specified in Para. 8.17 with an applied force of 10 (+1 -0)N.</p>
<p>Para. 1.8 Materials and Finishes</p>	<p>The relevant Declared Materials List for this specification is Flux document: FT 08699003.</p>